US ARMY CORPS OF ENGINEERS
NORTHWESTERN DIVISION
MISSOURI RIVER BASIN
WATER MANAGEMENT DIVISION

SUPPLEMENTAL BIOLOGICAL ASSESSMENT FOR THE 2002-2003 ANNUAL OPERATING PLAN

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SUPPLEMENTAL BIOLOGICAL ASSESSMENT FOR THE 2002-2003 ANNUAL OPERATING PLAN

Introduction

In accordance with letters dated December 20, 2002 and December 26, 2002 between the U.S. Army Corps of Engineers (Corps) and the U.S. Fish and Wildlife Service (USFWS), this Supplemental Biological Assessment (BA) has been prepared on the flow-to-target release plan presented in the 2002-2003 Annual Operating Plan (AOP) for the Missouri River Mainstem Reservoir System (System). This Supplemental BA is for use in the formal consultation on the flow-to-target System release plan under Section 7 of the Endangered Species Act.

The BA discusses the potential effects of the flow-to-target operation on the interior least tern and piping plover. These effects are put in the context of the past success in meeting fledge ratio goals and the likelihood of again meeting the fledge ratio goals in 2003. The level of take that would likely result from the flow-to-target operation is identified. In light of the extreme drought conditions, substantial water conservation achieved by the flow-to-target operation and the likelihood of again meeting the fledge ratio goal outlined in the November 2002 Biological Opinion (BiOp), the Corps requests an incidental take of interior least terns and piping plovers associated with the flow-to-target operation for the 2003 nesting season.

Description of Runoff Scenarios

Due to continued drought throughout much of the Missouri River basin, simulation forecasts for the regulation of the System were updated from those presented in the Draft 2002-2003 AOP to reflect December 1, 2002 rather than August 1, 2002 conditions. The August 1 forecast of annual runoff above Sioux City, Iowa was 17.0 million acre-feet (MAF), but the December 1 forecast and actual 2002 runoff above Sioux City was 16.0 MAF. The December 1 most likely runoff scenario was used as input to the Basic reservoir regulation simulation (Simulation) in the AOP studies for December 2002. Normal runoff was used in the Basic Simulation for January and February 2003. Two other runoff scenarios based on the December 1 most likely runoff scenario were developed for the same period. These are the 80 percent and 120 percent of the most likely runoff scenarios, which are input to the 80 percent and 120 percent of Basic Simulation for the December 2002 to February 2003 period.

Simulations for the March 1, 2003 to February 29, 2004 time period use five statistically derived inflow scenarios based on an analysis of water supply records from 1898 to 1997. This approach provides a good range of simulations for dry, average, and wet conditions, and eliminates the need to forecast future precipitation, which is very difficult.

The Upper Decile and Upper Quartile Simulations extend from the end of the 120 percent of Basic Simulation through February 2004. Likewise, the Median Simulation extends from the end of the Basic Simulation, and the Lower Quartile and Lower Decile Simulations extend from the end of the 80 percent of Basic Simulation through February 2004.

Upper Decile runoff (34.5 million acre-feet (MAF)) has a 1 in 10 chance of being exceeded, Upper Quartile (30.6 MAF) has a 1 in 4 chance of being exceeded, and Median (24.6 MAF) has a 1 in 2 chance of being exceeded. Lower Quartile runoff (19.5 MAF) has a 1 in 4 chance of the occurrence of less runoff, and Lower Decile (15.5 MAF) has a 1 in 10 chance of the occurrence of less runoff. There is still a 20 percent chance that a runoff condition may occur that has not been simulated; i.e., 10 percent chance runoff could be lower than Lower Decile, and a 10 percent chance runoff could be greater than Upper Decile.

The estimated natural flow[1/] at Sioux City, the corresponding post-1949 water use effects, and the net flow[2/] available above Sioux City are shown in Table I**,** where several water supply conditions are quantified for the periods December 2002 through February 2003 and the runoff year March 2003 through February 2004. The natural water supply for calendar year (CY) 2002 (actual January 2002 through November 2002 runoff plus the December 1 most likely runoff scenario is estimated to total approximately 16.0 MAF.

Table I
Natural and Gross Water Supply at Sioux City

	Natural [1/]	Post-1949 Depletions	Net [2/]
	(Volumes in 1,000 Acre-Feet)		
December through February 2003 (Most Likely Runoff Scenario)			
Basic	2,600	+100	2,700
120% Basic	2,900	+200	3,100
80% Basic	2,000	0	2,000
Runoff Year March 2003 through February 2004 (Statistical Analysis of Past Records)			
Upper Decile	34,500	-2,500	32,000
Upper Quartile	30,600	-2,400	28,200
Median	24,600	-2,600	22,000
Lower Quartile	19,500	-2,400	17,100
Lower Decile	15,500	-2,200	13,300

[1/] The word "Natural" is used to designate flows adjusted to the 1949 level of basin development, except that regulation and evaporation effects of the Fort Peck Reservoir have also been eliminated during its period of operation prior to 1949. [2/] The word "Net" represents the total stream flow after deduction of the post-1949 irrigation, upstream storage, and other use effects.

Annual Operating Plan For 2002-2003

The anticipated operation described in the 2002-2003 AOP is designed to meet the operational objectives presented in the current Missouri River Master Water Control Manual (Master Manual), which was first published in the 1960's. Consideration has been given to all of the authorized project purposes, and to the needs of threatened and endangered (T&E) species. This AOP relies on a wealth of operational experience. Operational experience available for preparation of the 2002-2003 AOP includes 13 years of operation at Fort Peck Dam (1940) by itself plus 49 years of System experience as Fort Randall (1953), Garrison (1955), Gavins Point (1955), Oahe (1962), and Big Bend (1964) Dams, which have been brought progressively into System operation. This operational experience includes lessons learned during the 6 consecutive years of drought of the late-1980's and early 1990's and the high runoff period that followed. Runoff during the period 1993 to 1999 was greater than Upper Quartile level during 5 of those 7 years, including the record 49.0 MAF of runoff in 1997. In addition to the long period of actual operational experience, many background operational studies for the completed System are available for reference.

This operational experience has shown that additional water conservation measures, beyond the specific technical criteria published in the current Master Manual, may be required to meet the operational objectives of the current Master Manual, if System water-in-storage (storage) is below 52 MAF on July 1 of any year. These additional conservation measures may be necessary during drought to offset increased release requirements for water supply due to degradation (lowering) of the channel bed, and to serve navigation, while meeting the Corps' obligations under the ESA. After each runoff year (March 1 through February 28), an analysis is performed to determine how much additional water conservation, if any, is needed to compensate for releases in excess of the specific technical criteria in that runoff year. If additional water conservation measures are called for, they are applied to the next runoff year's operation. Although July 1, 2002 System storage was only 48.8 MAF, no additional System releases were made for any project purpose above the specific technical criteria in the 2001 runoff year. No additional conservation measures beyond the specific technical criteria presented in the Master Manual will, therefore, be implemented in the 2002 runoff year.

Two sets of Simulations for the 2003 runoff year are shown in the final section of the AOP. The first set, studies 4 through 8 assume a steady-release from Gavins Point Dam from mid-May through August to prevent T&E bird species from nesting at low elevations and thereby help protect them from inundation. The steady release Upper Decile and Upper Quartile Simulations, shown as studies 4 and 5, have a 27,200 cubic feet per second (cfs) System release to meet minimum service targets from mid-May through August 2003. The steady release Median, Lower Quartile, and Lower Decile Simulations assume a steady 30,000 cfs system release, reflecting continued dry conditions below Gavins Point Dam. System releases shown in previous AOPs were not absolute and adjustments were made as necessary to meet the navigation service level as determined by the March 15 and July 1 System storage checks. The assumption for the 2002-2003 AOP is that the 30,000 cfs steady release would not be exceed; therefore,

target flows may not be met at all times if extremely dry conditions persist downstream. Temporary reductions in releases will be made during this period if significant runoff occurs below the System. Steady-release Simulations for Median, Lower Quartile, and Lower Decile extensions from March 1, 2004 through March 1, 2009 are shown in studies 9 through 23. The second set of Simulations, studies 24 through 28, assume a flow-to-target regulation that was used during the 2001 T&E bird species nesting season. A flow-to-target regulation would typically result in increased System releases as the T&E nesting season progresses. This is due to reduced tributary inflows downstream as the summer heat builds, evaporation increases, and precipitation wanes. Flow-to-target Simulation extensions are shown as studies 29 through 43.

System releases during the navigation season, except for the mid-May through August Median, Lower Quartile, and Lower Decile steady-release Simulations, are based on a service level determination in accordance with the March 15 and July 1 storage checks presented in the current Master Manual. Average releases necessary to meet full service flow targets during the navigation season are shown in Table II. Under the steady-release Simulation, System release would be set in mid-May to the level expected to be required to meet downstream flow targets through August. This results in releases that exceed the amount necessary to meet downstream flow targets during the early portion of the T&E bird nesting season.

Table II
Gavins Point Dam Releases Needed to Meet Full Service Flow Targets
1950 - 1996
(Discharges in 1,000 cfs)

Runoff	Month								
Scenario	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Ave
Median, Upper Quartile, Upper Decile	26.7	28.0	27.9	31.6	33.2	32.6	32.0	31.1	30.4
Lower Quartile, Lower Decile	29.8	31.3	31.2	34.3	34.0	33.5	33.1	31.2	32.3

System releases under the flow-to-target Simulations would be set at only the level necessary to meet downstream flow targets. The flow-to-target regulation would conserve more water in the System, which would keep the lake levels at the upper three System projects at relatively higher levels. Although the maximum mid-May through August flow-to-target release for Median runoff is shown as 27,200 cfs in study 26 and 28,300 cfs in the Lower Quartile and Lower Decile runoff studies 27 and 28, releases could be greater if needed to maintain the appropriate level of downstream flow support. A flow-to-target regulation would conserve approximately 200,000 to 800,000 acre-feet as compared to a steady-release regulation.

The specific technical criteria for the September 1 storage check to determine winter release rates were not used in the Simulations. A minimum release of 13,000 cfs was used for all Simulations for the winter 2002-2003 and the winter 2003-2004. This will provide downstream winter flows sufficient to allow the operation of downstream powerplants, as provided for in the current Master Manual, and is based on past operational experience.

Application of the specific technical criteria for the September 1 storage check would result in winter releases above the 13,000-cfs level in 2003-2004 for the Upper Decile and Upper Quartile Simulations, but System winter releases will be held to 13,000 cfs as a water conservation measure during the current drought.

The 13,000-cfs winter release will be greater than that under the specific technical criteria for both the Basic and 80% Simulations for the winter of 2002-2003. This resulted in the use of an additional 536,000 AF compared to that used with the application of the specific technical criteria. Because releases in July and August 2002 were lower than those needed to provide minimum service in accordance with the USFWS interpretation of its November 2000 Biological Opinion, 378,000 AF of storage was conserved as compared to regulation under the specific technical criteria. The net reduction in storage in the 2002 runoff year was, therefore, 158,000 AF, as compared to regulation under the specific technical criteria.

Only the Median, Lower Quartile, and Lower Decile Simulations show System storage below 52 MAF on July 1, 2003. The Simulations for those three runoff scenarios also show that application of the specific technical criteria result in minimum service throughout the 2003 navigation season. Shortening of the 2003 navigation season is, therefore, the only available option for additional water conservation. If the Simulations verify, the 2003 navigation season would be shortened by 5 days for Median, Lower Quartile, and Lower Decile runoff to compensate for the additional water released during the winter 2002-2003. The Upper Quartile and Upper Decile Simulations forecast that System storage on July 1 will be above 52 MAF, and, therefore, would follow the specific technical criteria.

During the late 1980's-early 1990's drought years, a 2-day-down, 1-day-up peaking cycle was used. This regulation provided for lower flows for 2 out of 3 days to conserve water in the System while insuring that T&E bird species did not nest on low-lying habitat. A peaking cycle has not been included in any of the Simulations because of concerns regarding negative impacts to river fish. Intrasystem releases are adjusted to best serve the multiple-purpose functions of the upper three projects, with special emphasis placed on regulation for non-listed fisheries starting in early April and for T&E bird species beginning in early May and continuing through August. System releases for all runoff conditions are at less-than-full service flows due to low System storage.

A reanalysis of the average monthly Gavins Point Dam releases needed to meet service level targets requirements was completed in 1999. The study used the Daily Routing Model (DRM) for the period 1950 to 1996. As part of this study, the

relationship between annual runoff upstream of Sioux City and the average Gavins Point Dam release required for the navigation season was analyzed. The study concluded that generally more water was needed downstream to support navigation during years with below normal upper basin runoff than during years with higher upper basin runoff. Regulation studies since 1999, therefore, use two levels of System release requirements: one for Median, Upper Quartile, and Upper Decile runoff scenarios and another for Lower Quartile and Lower Decile scenarios.

The updated release requirements for full service navigation used in the development of the 2002-2003 AOP are given in Table II. Releases required for minimum service navigation support are 6,000 cfs less than the numbers provided in Table II. A final report detailing the procedures used in this study is available on the Northwestern Division's Water Management web site. As explained previously, the steady-release Median, Lower Quartile, and Lower Decile Simulations use a 30,000-cfs release from mid-May through August rather than the minimum service releases computed from Table II. This release is higher than the Table II values and reflects lower downstream tributary flow contributions than was used when the table was prepared.

None of the Simulations reach the desired 57.1 MAF system storage level on March 1, 2004. The Median and above Simulations include releases that provide a steady to rising lake level in the three large upper reservoirs during the spring fish spawn period. Similar regulation in the past has resulted in a higher fish reproduction success. As previously stated, Gavins Point Dam releases will not be cycled to conserve water under any of the five studied runoff scenarios; however, it may be necessary to cycle releases for flood control operations during the T&E species nesting season.

Effects of Flow-to-Target Simulations

A model was developed to assess the expected effect of the flow-to-target Simulations on least tern and piping plover eggs and chicks on the Missouri River between Gavins Point Dam and Ponca, Nebraska. The goal of the model was to provide an indication of the level of impacts that might occur under modeled flow Simulations. Impacts could change significantly with changes in the timing and magnitude of expected flows.

The model incorporated least tern and piping plover population and productivity parameters collected during 2002 breeding census and productivity monitoring activities. Piping plover and least tern nest initiation dates, nest loss due to non-flood factors (e.g. predation, human disturbance, abandonment), hatching rates, chick loss due to non-flood factors (e.g. predation, weather), chick survival, and fledging rates were modeled as weekly cohorts for the duration of the normal nesting season, described as the last week in April to the last week in August. Corresponding weekly flows were generated from the Median and Lower Decile Simulations for the AOP. Habitat availability was determined using November 2002 habitat estimates that were developed by sampling the elevation and availability of nesting habitat on ten randomly selected sandbars.

Each week, the model tracked nest initiations, nest loss, hatching, chick loss, and chick fledging using 2002 productivity parameters. The model was run under a steady release scenario, in which flooding caused no nest or chick losses, to verify that the resulting productivity estimates matched 2002 actual results. The flow-to-target Simulations were then modeled to estimate impacts. The model incorporated the following assumptions:

- Least tern and piping plover population and productivity parameters were identical to those observed in 2002.
- In terms of elevation, nests were placed on the habitat in proportion to its availability.
- Nest loss and chick loss due to non-flood factors occurred uniformly throughout the nesting period and brood rearing periods, respectively.
- Nest loss due to non-flood factors occurred randomly and was independent of nest elevation.
- Chick loss due to flooding occurred in proportion to the overall amount of habitat that was inundated by increased flows.

The impacts for two of the flow-to-target Simulations are presented in Table III.

Table III
Expected Impacts of Flow-to-Target Flows to Least Terns and Piping Plovers on the Missouri River between Gavins Point Dam and Ponca, Nebraska

	Least Terns		Piping Plovers		Total	
Flow	Eggs	Chicks	Eggs	Chicks	Eggs	Chicks
Median	25	44	40	42	65	86
Lower Decile	29	24	44	19	73	43

Actual impacts could vary significantly from these expected values with changes in the timing and magnitude of the expected flow scenarios. In a worst-case scenario, an extremely wet spring in the lower basin coupled with dry summer would lead to low spring releases from Gavins Point Dam and a significant increase in flow in the reach during the summer to meet downstream navigation targets. Under these conditions, impacts to least terns and piping plovers could be considerably greater than those expected. Conversely, a dry spring with adequate summer rains would decrease the magnitude of flow changes throughout the year and may reduce impacts to levels lower than expected.

Captive Rearing Results

The Corps' Omaha District has captive-reared least tern and piping plover eggs salvaged from the Missouri River during flood control activities since 1995. Table IV summarizes those activities.

Table IV
Captive-Reared Chicks and Tern and Plover Eggs Leading to Release Success since 1995

Terns				Plovers				
Year	Eggs Collect	Eggs Hatch	Release	Year	Chicks Collect	Eggs Collect	Eggs Hatch	Release
1995	160	112	74	1995	16	197	168	145
1996	203	183	164	1996	0	138	123	95
1997	24	19	16	1997	0	33	26	24
1998	0	0	0	1998	0	24	23	21
1999	35	30	23	1999	0	71	53	50
2000	0	0	0	2000	0	50	22	22
2001	22	22	20	2001	0	53	42	42
2002	12	12	10	2002	0	9	9	9
Total	456	378	307	Total	16	575	466	408

Estimated Captive-Reared Birds in 2003 Breeding Population

The number of captive-reared least terns and piping plovers that may be persisting in the 2003 breeding population was determined using minimum annual survival-rate estimates. These survival-rate estimates were developed from banding and recapture studies of wild least terns and piping plovers. The assumption in using these estimates is that captive reared birds are surviving at rates equal to wild reared birds. No survival rate estimates, post-release, are available for captive reared birds. Estimate includes only those birds physically reared in the captive rearing facility and does not include wild-reared progeny subsequently produced from these individuals.

The minimum 2003 breeding population estimate for captive-reared piping plovers is 56 individuals. This represents 4.9 percent of 2002 breeding census (1134 breeding adults) on the Missouri River, 1.9 percent of the 2001 Great Plains population breeding census (2953 breeding adults, and .09 percent of the 2001 International Piping Plover Census (5945 individuals).

Minimum 2003 breeding population estimate for captive-reared least terns is 44 individuals. This represents 6.0 percent of the 2002 breeding census (731 breeding adults) on the Missouri River. No other population census information is available for the least tern.

Table V presents the data tables used to generate these estimates.

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Table V
Historical Piping Plover and Least Tern Survival Rates (percent) Downstream from Gavins Point Dam.

Piping Plover Survival
First Year Survival = 0.48
Annual Adult Survival = 0.737

	Released	1996	1997	1998	1999	2000	2001	2002	2003
1995	145	69.60	51.30	37.80	27.86	20.53	15.13	11.15	8.22
1996	95		45.60	33.61	24.77	18.25	13.45	9.92	7.31
1997	24			11.52	8.49	6.26	4.61	3.40	2.50
1998	21				10.08	7.43	5.48	4.04	2.97
1999	50					24.00	17.69	13.04	9.61
2000	22						10.56	7.78	5.74
2001	42							20.16	14.86
2002	9								4.32
Total	408	69.60	96.90	82.93	71.20	76.47	66.92	69.48	55.53

Least Tern Survival
Fledging to Second Year Survival = 0.30
Annual Adult Survival = 0.85

	Released	1996	1997	1998	1999	2000	2001	2002	2003
1995	74		22.20	18.87	16.04	13.63	11.59	9.85	8.37
1996	164			49.20	41.82	35.55	30.21	25.68	21.83
1997	16				4.80	4.08	3.47	2.95	2.51
1998	0					0.00	0.00	0.00	0.00
1999	23						6.90	5.87	4.99
2000	0							0.00	0.00
2001	20								6.00
2002	10								
Total	307	0.00	22.20	68.07	62.66	53.26	52.17	44.35	43.69

Table VI displays adult population and fledge ratio information for the past 10 years by reach and the total for the Missouri River System. Fledge ratios goals outlined in the Biological Opinion issued in November 2000 have been met in 4 out of the past 5

years for piping plovers and the last 3 years for terns; however, the Biological Opinion prescribes that fledge ratios be calculated on a 3-year running average. Even if the impacted birds below Gavins Point Dam do not add to the productivity this nesting season, the 3-year running average fledge ratio goals of 1.13 for piping plovers and 0.70 for the least tern will be met (see Appendix A for this and subsequent computations of 3-year running average). For instance, assuming the 3-year average number of adults return to the river in 2003, only 41 plovers need to be fledged to meet the 3-year average fledge ratio goal. Because of the extremely high number of fledged terns the last 2 years, no terns need to be fledged to meet the goal. The potential impact to terns and plovers due to the flow-to-target operation (Table III) is, therefore, not likely to affect the ability to meet the fledge ratio goals.

The Corps has also taken significant steps in implementing elements of the RPA and is committed to provide for the long-term habitat needs and sustainable recruitment of piping plovers and least terns. Highly intensive monitoring of population and productivity parameters is provided on an annual basis. Monitoring of habitat conditions on river segments is ongoing, and monitoring of reservoir habitats will be implemented in 2003 to allow us to better manage these habitats for the benefit of least terns and piping plovers. Unbalanced intrasystem regulation of the reservoirs has provided, and will continue to provide, significant habitat on the reservoirs, and investigations by the Corps are underway to identify potential habitat enhancement projects in these areas. While habitat goals on river segments have recently been met, following the 1997 high water, the Corps initiated projects for constructing and maintaining this habitat to insure that future performance goals will be met. The Corps has also initiated several research projects called for in the RPA, including a piping plover foraging ecology study and a post-release survival study.

In light of the above productivity information, the ongoing implementation of RPA elements to meet the long-term needs of the species, and the high likelihood that the 3-year running average for fledge ratios will again be met, the Corps requests an incidental take statement allowing for the incidental take of least terns and piping plovers associated with the flow-to-target release scenario for the 2003 nesting season. The incidental take statement should specify whether the take can include captive rearing of eggs and chicks threatened by the flow-to-target flow operation. The take would be incidental to meeting authorized project purposes as outlined in the AOP in accordance with the Master Manual.

Table VI
Missouri River Mainstem Tern and Plover Survey Data

	Interior Least Tern												
	1990	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**
Fort Peck Lake													
Adults	6	10	0	7	9	2	0	0	4	0	0	0	0
Fledglings/Pair	0	0.40	0	0	0.44	0	0	0	0	0	0	0	0
Fort Peck to Lake Sakakawea													
Adults	92	66	110	31	58	95	128	162	25	40	13	39	34
Fledglings/Pair	0.17	0.55	0.25	0.45	1.41	0.99	0.33	0.53	.1.52	1.70	0.15	0.97	0.59
Lake Sakakawea													
Adults	6	8	29	17	35	7	27	2	23	9	10	34	21
Fledglings/Pair	0	0	0.83	0.12	0	0	0.15	0	1.04	0.67	0.20	0.76	0.86
Garrison to Lake Oahe													
Adults	174	195	198	145	217	284	105	41	141	105	105	125	126
Fledglings/Pair	0.44	0.58	0.48	0.28	0.54	0.91	0.08	0.39	1.52	1.50	1.03	1.26	1.83
Lake Oahe													
Adults	100	143	124	125	160	84	74	101	110	57	85	94	106
Fledglings/Pair	0	0	0.42	0	0.06	0	0.24	0.16	1.29	0.88	1.01	1.34	1.32
Ft. Randall to Niobrara													
Adults	26	32	13	38	43	10	2	0	64	124	72	71	84
Fledglings/Pair	0.31	0.63	0.46	0	0	0	0	0	0.94	1.03	1.26	0.14	0.71
Lake Lewis and Clark													
Adults	63	55	29	76	44	16	28	60	120	76	44	58	46
Fledglings/Pair	0.35	0	1.59	0.97	0	0	0	1.57	2.33	0.21	0.38	1.17	1.04
Gavins Point to Ponca													
Adults	167	193	187	272	211	93	82	115	148	161	149	232	314
Fledglings/Pair	0.46	0.26	0.21	0.83	0.48	0.49	0.27	0.90	2.27	2.41	1.72	1.09	1.32
Total Adults	634	702	690	711	777	591	446	481	635	572	551	653	731
Fledglings/Pair	0.38	0.41	0.42	0.50	0.41	0.67	0.21	0.66	1.73	1.42	1.22	1.04	1.27

Ten Year Interior Least Tern Fledge Ratio Goal = 0.70

Table VI
Missouri River Mainstem Tern and Plover Survey Data (continued)

	Piping Plover												
	1990	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**
Fort Peck Lake													
Adults	22	25	26	30	4	5	0	0	4	2	0	4	2
Fledglings/Pair	3.18	1.20	1.00	0.60	1.50	1.20	0	0	0	2.00	0	1	2
Fort Peck to Lake Sakakawea													
Adults	17	13	0	4	9	20	24	23	4	5	4	3	2
Fledglings/Pair	0	0	0	0	0	3.50	1.00	0.87	1.00	0	0	1.33	0
Lake Sakakawea													
Adults	132	150	108	8	45	24	70	3	119	83	277	424	469
Fledglings/Pair	0	0	1.50	8.50	1.24	0	0.57	0.67	1.24	1.25	1.61	1.25	1.65
Garrison to Lake Oahe													
Adults	71	124	77	127	119	261	45	6	74	139	99	149	119
Fledglings/Pair	1.04	1.13	1.06	0.54	0.87	0.87	0.09	0	1.84	0.88	1.41	1.53	2.03
Lake Oahe													
Adults	88	87	143	66	85	30	21	31	98	46	141	184	203
Fledglings/Pair	0	0	0.97	0.33	0.09	0.93	0.29	1.29	1.06	0.30	1.45	1.41	2.16
Ft. Randall to Niobrara													
Adults	12	25	8	12	17	0	3	0	33	51	62	38	35
Fledglings/Pair	0.67	0.48	0.75	0	0	0	0	0	1.27	1.02	0.87	0.74	1.03
Lake Lewis and Clark													
Adults	30	33	6	32	12	4	6	32	84	67	28	34	44
Fledglings/Pair	0.67	0	0	0.06	0.33	0	0	1.25	2.45	0.30	0.5	0.71	1.68
Gavins Point to Ponca													
Adults	148	166	112	109	62	63	22	22	49	141	186	218	260
Fledglings/Pair	0.39	0.35	0.34	1.06	0.61	0.16	0	0	2.20	1.60	2.17	1.85	2.29
Total Adults	521	623	480	388	353	407	191	117	465	534	797	1054	1134
Fledglings/Pair	0.76	0.62	0.94	0.76	0.61	0.84	0.39	0.87	1.61	1.01	1.58	1.41	1.91

Fifteen Year Piping Plover Fledge Ratio Goal = 1.13

\- Data not collected

* Partial Survey Results

{} No Birds Found

\+ Subsamplng of Selected Nesting Areas

The data does not include least terns and piping plovers raised in captivity. The data represents only wild fledged birds.

Appendix A

Calculation of 3-year average fledge ratio goal

Least tern
2000 – 2003 adults = 1,959
2000 – 2002 fledglings = 1,115
200-2002 fledge ratio = 1.18
2001 –2003 adults = 2,076*
2001- 2002 fledglings = 806
Number of fledglings needed to meet 3 year (2001 –2003) average fledge ratio of .70 = 725
Number of fledglings needed in 2003 to meet 3-year average = -81

Piping plover
2000-2002 adults = 2,986
2000 – 2002 fledglings = 2,450
2000 –2002 fledge ratio = 1.64
2001 – 2003 adults = 3282*
2001 – 2002 fledglings 1,813
Number of fledglings needed to meet 3 year (2001 –2003) average fledge ratio of 1.13 = 1,854
Number of fledglings needed in 2003 to meet 3-year average = 41

* - Assumes average (2001 –2002) number of adults return in 2003

Appendix B

AOP Simulation Run Results